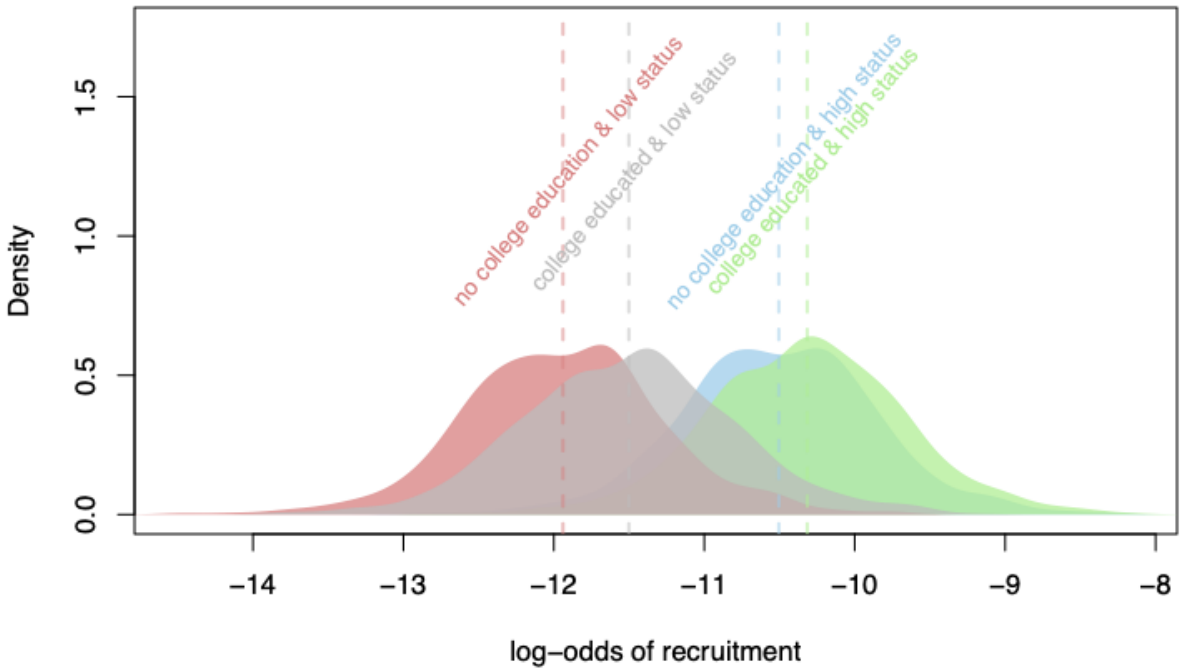
Explaining Recruitment to Extremism: A Bayesian Hierarchical Case-Control Approach



Repo of replication materials for "Explaining Recruitment to Extremism: A Bayesian Hierarchical Case-Control Approach." This is the final version control repository without data output (too large for Github). For full replication dataverse, see: https://doi.org/10.7910/DVN/HYOQCD.

Note that there will be small changes in the point estimates and convergence diagnostics etc. due to minor differences as a result of MCMC sampling used in the analysis.

Package installation

The estimation procedure described in this article is provided as a standalone package called `extremeR`: https://github.com/cjbarrie/extremeR. The package has a standalone website, including tutorial run-through at: https://extremer.info/.

Description of data

We use three main sources of data. These are all in the folder "data/".

1. The principal raw data come leaked recruitment records. These are provided (with names, address etc.) as "master_data.csv."
2. There are then three data sets of recruitment records merged with survey and administrative data. For all countries, this file is "matchadata_isisall.csv"; for Egypt "matchdata_isisegysc.csv"; and for Tunisia "matchdata_isistunsc.csv".
3. The final dataset, "mena_pops.csv" is a list of population figures needed for the estimation procedure.

Variables

For full descriptions of each variable and how they were coded, see the Appendix of the published article. Below, we detail short descriptions of each variable for ease of reference.

master_data.csv

Variable Name	Description
person_ID	unique identifier for each individual
country	name of the country where the individual lives
name_0	alternative country ID
country_ID	alternative country ID
governorate	name of the governorate where the individual lives
name_1	alternative governorate ID
governorate_ID	alternative governorate ID
gov_x	x-coordinate of the governorate
gov_y	y-coordinate of the governorate
case	individual is case 1/0
edu_years	number of years of education completed by the individual
level_edu_ABIII	educational level of the individual accorded with Arab Barometer
coledu	individual attended college
coledu_any	individual attended any college
age	age of the individual
married	indicator variable for whether the individual is married
student	indicator variable for whether the individual is a student
unemployed	indicator variable for whether the individual is unemployed
agriman	indicator variable for whether the individual is in agricultural or manual work
lowstat	indicator variable for whether the individual is low status

matchdata_isisall.csv.csv

Variable Name	Description
ID	unique identifier for each individual
country	name of the country where the individual lives
governorate	name of the governorate where the individual lives
edu_years	number of years of education completed by the individual
level_edu_ABIII	educational level of the individual accorded with Arab Barometer
coledu	individual attended college
coledu_any	individual attended any college
age	age of the individual
married	indicator variable for whether the individual is married
student	indicator variable for whether the individual is a student
unemployed	indicator variable for whether the individual is unemployed
agriman	indicator variable for whether the individual is in agricultural or manual work
lowstat	indicator variable for whether the individual is low status
case	individual is case 1/0

matchdata_isisegysc.csv

Variable Name	Description
country	name of the country where the individual lives
governorate	name of the governorate where the individual lives
district	name of the district where the individual lives
edu_years	number of years of education completed by the individual
level_edu_ABIII	educational level of the individual accorded with Arab Barometer
coledu	individual attended college
coledu_any	individual attended any college
age	age of the individual
married	indicator variable for whether the individual is married
student	indicator variable for whether the individual is a student
unemployed	indicator variable for whether the individual is unemployed
agriman	indicator variable for whether the individual is in agricultural or manual work
lowstat	indicator variable for whether the individual is low status
total_population_2006	total population count in 2006
christian_2006_pct	percentage of the population that identifies as Christian in 2006
agriculture_2006_pct	percentage of the population that is employed in agriculture in 2006
university_2006_pct	percentage of the population that has a university education in 2006
population_density	population density in the district
district_x	x-coordinate of the district
district_y	y-coordinate of the district
mursi_vote_2012_pct	percentage of the district vote that was for Mursi in 2012
unemployment_2013q4_pct	unemployment rate in the district in Q4 of 2013
sqrt_killed_at_rabaa	square root of the number of individuals killed at the Rabaa al-Adawiya sit-in
distance_to_cairo	distance from the district to Cairo
sqrt_distance_to_cairo	square root of the distance from the district to Cairo
protest_post_Mubarak	number of protests in the district after the overthrow of Mubarak
sqrt_protest_post_Mubarak	square root of the number of protests in the district after the overthrow of Mubarak
distance_to_north_sinai	distance from the district to North Sinai
sqrt_distance_from_north_sinai	square root of the distance from the district to North Sinai
admin2Name_en	name of the district in English (from shapefile)
admin2Name_ar	name of the district in Arabic (from shapefile)
adm2_pcode	unique identifier for each district (from shapefile)
admin1Name_en	name of the governorate in English (from shapefile)
admin1Name_ar	name of the governorate in Arabic (from shapefile)
admin1Pcode	unique identifier for each governorate (from shapefile)
case	individual is case 1/0

matchdata_isistunsc.csv

Here's a markdown table with two columns, one for the variable name, and one for a description of the variable:

Variable name	Description
country	name of the country where the individual lives
governorate	name of the governorate where the individual lives
delegation	name of the delegation where the individual lives
edu_years	number of years of education completed by the individual
level_edu_ABIII	educational level of the individual accorded with Arab Barometer

Variable name	Description
coledu	individual attended college
coledu_any	individual attended any college
age	age of the individual
married	indicator variable for whether the individual is married
student	indicator variable for whether the individual is a student
unemployed	indicator variable for whether the individual is unemployed
agriman	indicator variable for whether the individual is in agricultural or manual work
lowstat	indicator variable for whether the individual is low status
population_density	population density in the delegation
log_population_density	log of population density in the delegation
case	individual is case 1/0
pop_10plus_2014	population age 10 years and above in 2014
pct_higher_edu_2014	percentage of population with higher education in 2014
pct_illit_2014	percentage of population illiterate in 2014
unemp_rate_2014	unemployment rate in 2014
dip_unemp_rate_2014	graduate unemployment in 2014
pct_agri_2014	percentage of population working in agriculture in 2014
unemp_rate1519_2014	unemployment rate for the population age 15-19 years in 2014
unemp_rate2024_2014	unemployment rate for the population age 20-24 years in 2014
unemp_rate2529_2014	unemployment rate for the population age 25-29 years in 2014
internet_use_2014	percentage of population with internet in 2014
idr	delegation development index
idr_rank	rank of delegation development index
pop_10_plus_male_2014	male population age 10 years and above in 2014
pop_15_plus_2014	population age 15 years and above in 2014
pop_15_plus_male_2014	male population age 15 years and above in 2014
dip_unemp_rate_male_2014	male graduate nemployment rate in 2014
unemp_rate_male_2014	male unemployment rate in 2014
distance_to_libya	distance to the border with Libyas
sqrt_distance_to_libya	square root of the distance to the border with Libya
distance_to_tunis	distance to Tunis in kilometers
sqrt_distance_to_tunis	square root of the distance to Tunis
post_rev_protest_events	number of protest events after the 2011 Revolution

Computational requirements

- Software used for final replication:

```
platform       aarch64-apple-darwin20
arch           aarch64
os             darwin20
system         aarch64, darwin20
status
major          4
minor          2.3
year           2023
month          03
day            15
svn rev        83980
language       R
```

```
version.string R version 4.2.3 (2023-03-15)
nickname       Shortstop Beagle
```

- Hardware used for final replication:

```
Model Name: MacBook Pro
Model Identifier: MacBookPro18,3
Model Number: Z15G0026LB/A
Chip: Apple M1 Pro
Total Number of Cores: 8 (6 performance and 2 efficiency)
Memory: 32 GB
System Firmware Version: 8419.80.7
OS Loader Version: 8419.80.7
Serial Number (system): C3YH39D4FF
Hardware UUID: FA2D6AD0-E4D6-54E5-95DF-F4BC76BDA020
Provisioning UDID: 00006000-001C41020A29801E
Activation Lock Status: Enabled
```

- Processing time for final analysis:
  - 000_simulation_study_round1.R : ~12 hours
  - 000_simulation_study_round2.R : ~12 hours
  - 01_analysis_egypt.R: ~3 hours
  - 02_analysis_tunisia.R: ~8 hours
  - 03b_analysis_bird.R: ~47 hours

File structure

Analysis scripts

- |– 000_simulation_study_round1.R : Runs first set of simulations
- |– 000_simulation_study_round2.R : Runs second set of simulations
- |– 01_analysis_egypt.R : "Worm's Eye" model estimation for Egypt
- |– 02_analysis_tunisia.R : "Worm's Eye" model estimation for Tunisia
- |– 03a_cleaning_bird.R : "Bird's Eye" model estimation data preparation
- |– 03b_analysis_bird.R: "Bird's Eye" model estimation

```
|-- 000_simulation_study_round1.R
|-- 000_simulation_study_round2.R
|-- 01_analysis_egypt.R
|-- 02_analysis_tunisia.R
|-- 03a_cleaning_bird.R
|-- 03b_analysis_bird.R
|-- README.md
|-- bayesian-extreme.Rproj
|-- bird.stan
|-- data
|   |-- master_dataset.csv
|   |-- matchdata_isisall.csv
|   |-- matchdata_isisegysc.csv
|   |-- matchdata_isistunsc.csv
|   |-- mena_pops.csv
|-- egypt.stan
```

```
|-- generated_data
|   |-- Bird
|   |-- Egypt
|   |-- Sims
|   |-- Tunisia
|-- figures
|   |-- Bird
|   |-- Egypt
|   |-- Sims
|   |-- Tunisia
|-- shapefiles/
|-- tables/
|-- tunisia.stan
|-- utils
    |-- monitornew.R
    |-- monitorplot.R
    |-- utils.R
    |-- utils_plot.R
```

Dependencies

1. To run the code requires pre-installing JAGS. This can be found here: https://sourceforge.net/projects/mcmc-jags/files/latest/download.
2. Either the testing or stable versions of `inla` should be installed from here: https://www.r-inla.org/download-install. In our experiments `inla` was more easily installed on Windows using the testing version.

Potential errors with shapefiles

A series of potential errors were flagged to the authors by the replicator. These errors were not reproducible for the authors, but we nevertheless flag them below and link to potential solutions. Generally speaking, the errors involved a) issues with unreadable or missing shx files; b) issues related to packages `sf` and `rgdal`:

1. `*GDAL Error 4:..../shapefiles/tun_adm1/TUN_adm1.shx or .....(2)/shapefiles/tun_adm1/TUN_adm1.SHX. Set SHAPE_RESTORE_SHX config option to YES to restore or create it. Execution halted*`

This error can show up when loading in the Tunisia shapefile, or other shapefiles. The issue could be caused by the absence of an shx file in the same folder as the shp file. There may be multiple causes to this, one of which could be issues with unzipping shapefiles: https://stackoverflow.com/questions/61282572/cant-read-shp-file-in-r.

2. `*CRS: NA Error in CPL_get_z_range(obj, 1) : z error - expecting three columns; Calls: collect_and_connect_shapes ... st_z_range.POLYGON -\> zb_wrap -\> stopifnot -\> CPL_get_z_range*`

This error is discussed in the following thread: https://github.com/r-spatial/sf/issues/1592#issuecomment-1192492161. Using the latest up-to-date versions of packages `rgdal` and `sf` typically resolves the issue.

3. `*Error: Cannot open .....shp"; The source could be corrupt or not supported. See `st_drivers()` for a list of supported formats. In addition: Warning message:*`

To our understanding this is again an error related to unreadable or non-existent shx files. Potential solutions involving the recreation of the shx file are discussed here: https://stackoverflow.com/questions/73308906/source-could-be-corrupt-or-not-supported.

4. `*Error in s2_geography_from_wkb(x, oriented = oriented, check = check) : Evaluation error: Found ... features with invalid spherical geometry.*`

This error can be avoided by setting `sf::sf_use_s2(FALSE)`. This turns off the s2 processing in `sf` (i.e. it ignores the 'spherical' nature of distances in spatial data - more information available here: https://r-spatial.github.io/sf/articles/sf7.html).

Potential errors with simulation study:

Using R via RStudio in Windows we have observed that, depending on your R settings, you may get the following error if you run round 1 and round 2 of the simulation study one after the other :

```
*Error in inDL(x, as.logical(local),as.logical(now),...) :
unable to load shared object 'C:/Users....':
maximal number of DLLs reached*
```

This error indicates you've reached the maximum number of dynamically loaded libraries (DLLs) that can be loaded into R at one time.

To avoid this simply restart your R session after round 1.

Alternatively, if you see this error in the middle of your round 2, simply restart your R session and continue from where the study was interrupted. The code saves the last executed simulation in local, and provided the `new_sims` argument is set to `FALSE`, the code will remember what iteration is supposed to be executed next.